REMARKS

The Office Action mailed September 11, 2008, has been carefully reviewed and the foregoing amendment has been made in consequence thereof.

Claims 1-31 are now pending in this application. Claims 1-31 stand rejected. Claim 3 has been canceled in this amendment.

The objection to Claim 3 as allegedly being a substantial duplicate of Claim 2 is respectfully traversed.

Claim 3 has been canceled. Applicants submit that such amendment overcomes the objection and notification to that effect is solicited.

The objection to Claim 25 for allegedly informally reciting limitations is respectfully traversed. Claim 25 has been amended to recite "for every m1 number of times of frequency encoding." Applicants submit that such amendment overcomes the objection and notification to that effect is solicited.

The objection to Claim 29 for allegedly informally reciting limitations is respectfully traversed. Claim 29 has been amended to recite "for every m1 number of times of frequency encoding." Applicants submit that such amendment overcomes the objection and notification to that effect is solicited.

The objection to Claim 28 for allegedly informally reciting limitations is respectfully traversed. Claim 28 has been amended to recite "a receiver for receiving magnetic resonance (MR) signals representative of an object." Applicants submit that such amendment overcomes the objection and notification to that effect is solicited.

The rejection of Claims 1-20, 25, 26, and 29-31 under 35 U.S.C. § 101 for allegedly claiming an invention directed to non-statutory subject matter is respectfully traversed.

Claim 1 has been amended to recite "a method for medical examination using a magnetic resonance imaging (MRI) machine." In Re Bilski, the court held, "an applicant may show that a process claim satisfies [35 U.S.C.] § 101 by showing that his claim is tied to a particular machine, or by showing that his claim transforms an article." Applicants submit that such amendment overcomes the rejection and notification to that effect is solicited.

Claim 3 has been canceled. Claims 2, 4-20, 30, and 31 depend, directly or indirectly, from Claim 1. When the recitations of Claims 2, 4-20, 30, and 31 are combined with the recitations of Claim 1, Applicants respectfully submit that the Claims 2, 4-20, 30, and 31 are submitted in submitted in condition for allowance.

Claim 25 recites "acquiring MR signals produced by spins in the vasculature from an MR imaging system." In Re Bilski, the court held, "an applicant may show that a process claim satisfies [35 U.S.C.] § 101 by showing that his claim is tied to a particular machine, or by showing that his claim transforms an article." Applicants submit that such amendment overcomes the objection and notification to that effect is solicited.

Claim 26 has been amended to recite "a method for a medical examination using a magnetic resonance imaging (MRI) machine." In Re Bilski, the court held, "an applicant may show that a process claim satisfies [35 U.S.C.] § 101 by showing that his claim is tied to a particular machine, or by showing that his claim transforms an article." Applicants submit that such amendment overcomes the objection and notification to that effect is solicited.

Claim 29 has been amended to recite "a magnetic resonance (MR) controller programmed to." In Re Bilski, the court held, "an applicant may show that a process claim satisfies [35 U.S.C.] § 101 by showing that his claim is tied to a particular machine, or by showing that his claim transforms an article." Applicants submit that such amendment overcomes the objection and notification to that effect is solicited.

For at least the above reasons Applicants respectfully request that the Section 101 rejection of Claims 1-20, 25, 26, and 29-31 be withdrawn.

The rejection of Claims 1-7, 9, 10, 12, 16-19, 26, and 28-31 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Pat. No. 4,727,325 to Matsui et al. (hereinafter referred to as "Matsui") in view of U.S. Pat. No. 5,892,358 to King (hereinafter referred to as "King"), further in view of U.S Pat. No. 6,068,595 to Miyazaki et al. (hereinafter referred to as "Miyazaki") and further in view of U.S. Pat. Pub. 2001/0041819 to Goto (hereinafter referred to as "Goto") is respectfully traversed.

Matsui describes a NMR imaging method using a rotating field gradient, including a second step of generating field gradient in a predetermined direction to translate the position of signal in a phase space to appropriate locations, and a third step of generating a rotating

field gradient to perform a measuring operation. The rotating field gradient produces a spiral or circular sampling of k-space which is then reconstructed through Fourier transformation or a combination of 2D interpolation and Fourier transformation to produce an image. The method includes varying the amplitude of a field gradient waveform and/or an angular frequency at which a field gradient vector is rotated. Signal sampling includes generating a 90° RF pulse and a field gradient G_Z to excite nuclear spins in a desired slice portion of an object to be inspected. When a time τ has elapsed after the peak of the 90° RF pulse, a 180° RF pulse is generated to form transverse magnetization when a time τ has elapsed after the 180° RF pulse, i.e., at a time $t=0$. At the time $t=0$, the field gradients G_x and G_y are generated, and a signal sampling operation is started.

King describes a method of magnetic resonance imaging using sampling points on an anisotropic spiral trajectory.

Miyazaki describes a method of magnetic resonance imaging wherein data reconstruction is accomplished either through a Fourier transform of raw data acquired by magnetic scan under a state wherein pulsed gradients are applied to the subject in phase-encoding, or through pixel addition or maximum intensity projection (MIP). To scan a patient (P), a controller (6) commands a sequencer (5) to start scanning. In response to the command, the sequencer (5) drives a transmitter (8T) and a gradient power supply (4), according to pulse-sequence information that is transmitted and stored, and executes scanning. For a first scan, fast spin echo imaging is selected, the phase-encoding direction is set to the Z-axis direction, and the readout direction is set to the X-axis direction (step S5-2). A phase-encoding direction for a second scan is set to a direction deviated from the phase-encoding direction for the first scan. For example, the phase-encoding direction is changed to the X-axis direction and the readout direction is changed to the Z-axis direction.

Goto describes a method of magnetic resonance imaging included a phase encode gradient that is varied during a pulse sequence to carry out the phase encoding.

Claim 1 recites "a method for a medical examination using a magnetic resonance imaging (MRI) machine comprising…polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid, wherein said phase

encoding comprises phase encoding in which each datum is represented as m(acos(2πd/n)kx + bsin(2πd/n)ky + ickz, a, b, c, and d are real numbers, m, n, and i are an integers, and kx, ky, and kz being unit basis vectors in the k-space...forming a nested loop, the nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times."

None of Matsui, King, Miyazaki, and Goto, separately or in combination, describes or suggests the method of Claim 1. More specifically, none of Matsui, King, Miyazaki, and Goto, separately or in combination, describes or suggests "forming a nested loop, the nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times." Rather, Matsui describes a NMR imaging method using a rotating field gradient, including a second step of generating a field gradient in a predetermined direction to translate the position of signal in a phase space to appropriate locations, and a third step of generating a rotating field gradient to perform a measuring operation, King merely describes a method of magnetic resonance imaging using sampling points on an anisotropic spiral trajectory, Miyazaki merely describes data reconstruction through pixel addition or maximum intensity projection (MIP), and Goto merely describes a method of magnetic resonance imaging incorporating pulse sequences which are repeated.

Notably, none of Matsui, King, Miyazaki, and Goto, separately or in combination, describes or suggests "forming a nested loop, the nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for

every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times."

For at least the above reasons, Applicants respectfully submit that Claim 1 is patentable over Matsui in view of King, further in view of Miyazaki, and further in view of Goto.

Claims 2-7, 9, 10, 12, 16-19, and 30-31 depend, directly or indirectly, from independent Claim 1. When the recitations of Claims 2-7, 9, 10, 12, 16-19, and 30-31 are combined with the recitations of Claim 1, Applicants respectfully submit that Claims 2-7, 9, 10, 12, 16-19, and 30-31 are likewise patentable over Matsui in view of King, further in view of Miyazaki, and further in view of Goto.

Claim 26 recites "a method for a medical examination using a magnetic resonance imaging (MRI) machine ...sampling datasets on to an elliptical grid in polar coordinates in a k-space to generate signals representative of an object of interest that is being medically examined, wherein the dataset are frequency encoded in a Z-direction of the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid, said sampling comprises phase encoding in which each datum is represented as m(acos(2πd/n)kx + bsin(2πd/n)ky + ickz, a, b, c, and d are real numbers, m, n, and i are an integers, and kx, ky, and kz being unit basis vectors in the k-space...forming a nested loop, the nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times."

None of Matsui, King, Miyazaki, and Goto, separately or in combination, describes or suggests the medical examination of Claim 26. More specifically, none of Matsui, King, Miyazaki, and Goto, separately or in combination, describes or suggests "forming a nested loop, the nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b,

n, and c constant and varying d for every n2 number of times of radial phase encoding…phase encoding rotationally for n3 number of times." Rather, Matsui describes a NMR imaging method using a rotating field gradient, including a second step of generating a field gradient in a predetermined direction to translate the position of signal in a phase space to appropriate locations, and a third step of generating a rotating field gradient to perform a measuring operation, King merely describes a method of magnetic resonance imaging using sampling points on an anisotropic spiral trajectory, Miyazaki merely describes data reconstruction through pixel addition or maximum intensity projection (MIP), and Goto merely describes a method of magnetic resonance imaging incorporating pulse sequences which are repeated.

Notably, none of Matsui, King, Miyazaki, and Goto, separately or in combination, describes or suggests "forming a nested loop, the nested loop comprising…frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i…phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding…phase encoding radially for n2 number of times…phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding…phase encoding rotationally for n3 number of times."

For at least the above reasons, Applicants respectfully submit that Claim 26 is patentable over Matsui in view of King, further in view of Miyazaki, and further in view of Goto.

Claim 28 recites "a magnetic resonance imaging (MRI) system comprising…a main magnet to generate a uniform magnetic field…a radio frequency pulse generator for exciting the magnetic field…a gradient field generator for generating gradients extending in different directions in the magnetic field…a receiver for receiving magnetic field magnetic resonance (MR) signals representative of an object…a controller for polar phase encoding to generate the MR signals forming datasets representative of the object by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid, said controller configured to…phase encoding by representing each datum as m(acos(2πd/n)kx + bsin(2πd/n)ky + ickz, a, b, c, and d are real numbers, m, n, and i are an integers, and kx, ky, and kz being unit basis vectors in the k-space…form a nested loop, the nested loop

comprising…frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i…phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding…phase encoding radially for n2 number of times…phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding…phase encoding rotationally for n3 number of times."

None of Matsui, King, Miyazaki, and Goto, separately or in combination, describes or suggests the magnetic resonance imaging system of Claim 28. More specifically, none of Matsui, King, Miyazaki, and Goto, separately or in combination, describes or suggests a "nested loop comprising…frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i…phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding…phase encoding radially for n2 number of times…phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding…phase encoding rotationally for n3 number of times." Rather, Matsui describes a NMR imaging method using a rotating field gradient, including a second step of generating a field gradient in a predetermined direction to translate the position of signal in a phase space to appropriate locations, and a third step of generating a rotating field gradient to perform a measuring operation, King merely describes a method of magnetic resonance imaging using sampling points on an anisotropic spiral trajectory, Miyazaki merely describes data reconstruction through pixel addition or maximum intensity projection (MIP), and Goto merely describes a method of magnetic resonance imaging incorporating pulse sequences which are repeated.

Notably, none of Matsui, King, Miyazaki, and Goto, separately or in combination, describes or suggests a "nested loop comprising…frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i…phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding…phase encoding radially for n2 number of times…phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding…phase encoding rotationally for n3 number of times."

For at least the above reasons, Applicants respectfully submit that Claim 28 is patentable over Matsui in view of King, further in view of Miyazaki, and further in view of Goto.

Claim 29 recites "A magnetic resonance controller programmed to...polar phase encode to generate a plurality of magnetic resonance (MR) signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid, wherein said polar phase encoding comprises phase encoding in which each datum is represented as m(acos(2πd/n)kx + bsin(2πd/n)ky) + jr(acos(2πd/n)kx + bsin(2πd/n)ky) + ickz, a, b, c, d, and r are real numbers, m, j, n, and i are an integers, and kx, ky, and kz being unit vectors in the k-space...form a nested loop, the nested loop comprising...frequency encoding the datasets m1 times along a kz axis by keeping m, a, d, n, b, j, r, and c constant, and varying i...phase encoding radially once by keeping a, d, n, b, j, r, and c constant and varying m for every m1 number of times of frequency encoding...phase encoding radially for m2 number of times...phase encoding translationally once by keeping a, d, n, b, r, and c constant and varying j for every m2 number of times of radial phase encoding...phase encoding translationally for m3 number of times...phase encoding rotationally once by keeping a, n, b, r, and c constant and varying d for every m3 number of times of translational phase encoding...phase encoding rotationally for m4 number of times."

None of Matsui, King, Miyazaki, and Goto, separately or in combination, describes or suggests the magnetic resonance controller of Claim 29. More specifically, none of Matsui, King, Miyazaki, and Goto, separately or in combination, describes or suggests a "nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times." Rather, Matsui describes a NMR imaging method using a rotating field gradient, including a second step of generating a field gradient in a predetermined direction to translate the position of signal in a phase space to appropriate locations, and a third step of generating a rotating field gradient to perform a measuring

operation, King merely describes a method of magnetic resonance imaging using sampling points on an anisotropic spiral trajectory, Miyazaki merely describes data reconstruction through pixel addition or maximum intensity projection (MIP), and Goto merely describes a method of magnetic resonance imaging incorporating pulse sequences which are repeated.

Notably, none of Matsui, King, Miyazaki, and Goto, separately or in combination, describes or suggests a "nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times."

For at least the above reasons, Applicants respectfully submit that Claim 29 is patentable over Matsui in view of King, further in view of Miyazaki, and further in view of Goto.

For at least the above reasons, Applicants respectfully request that the Section 103 objection of Claims 1-7, 9, 10, 12, 16-19, 26, and 28-31 be withdrawn.

Further, Applicants respectfully submit that the Section 103 objection of Claims 1-7, 9, 10, 12, 16-19, 26, and 28-31 is improper. On page 6 of the office action the Examiner stated "the specific equation claimed and the nested loop does not hold patentable criticality to the claimed invention." Applicants respectfully submit that the Applicants and not the Examiner are responsible for determining what is, and what is not, claimed as the invention. Furthermore, Applicants respectfully submit that in at least paragraph [0032], Applicants disclosed "that the order in which this k-space sampling is performed is an important aspect of the systems and methods of polar phase encode placement."

For at least this reason alone, Applicants respectfully submit that the Section 103 rejection of Claims 1-6, 9, 10, 12, 16-19, 26, and 28-31 is improper.

The rejection of Claims 1-7 and 26 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Pat. No. 6,486,670 to Heid (hereinafter referred to as "Heid") in view of U.S. Pat. No. 5,892,358 to King (hereinafter referred to as "King"), further in view of U.S Pat. No. 6,068,595 to Miyazaki et al. (hereinafter referred to as "Miyazaki") and further in view of

U.S. Pat. Pub. 2001/0041819 to Goto (hereinafter referred to as "Goto") is respectfully traversed.

King, Miyazaki, and Goto are described above. Heid describes a method for imaging with NMR. The method includes reading out MR signals under the influence of a magnetic gradient field with the direction of a gradient being modified during the reception so that a k-space trajectory proceeds on a curve. The MR signals are then sampled with the sampling rate varied such that an occupation density of k-space with samples is essentially uniform. More specifically, the received magnetic resonance signals are sampled and digitized according to a time gradient curve. The curved k-space trajectory produces a spiral sampling of k-space. Interpolation samples are arranged on a rectangular grid in k-space and are generated by interpolating (14) the spiral samples (4).

Claim 1 recites "a method for a medical examination using a magnetic resonance imaging (MRI) machine comprising…polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid, wherein said phase encoding comprises phase encoding in which each datum is represented as $m(a\cos(2\pi d/n)kx + b\sin(2\pi d/n)ky + ickz$, a, b, c, and d are real numbers, m, n, and i are an integers, and kx, ky, and kz being unit basis vectors in the k-space…forming a nested loop, the nested loop comprising…frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i…phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding…phase encoding radially for n2 number of times…phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding…phase encoding rotationally for n3 number of times."

None of Heid, King, Miyazaki, and Goto, separately or in combination, describes or suggests the method of Claim 1. More specifically, none of Hedi, King, Miyazaki, and Goto, separately or in combination, describes or suggests "forming a nested loop, the nested loop comprising…frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i…phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding…phase encoding radially for n2 number of times…phase encoding rotationally once by keeping a, b, n, and c constant

and varying d for every n2 number of times of radial phase encoding…phase encoding rotationally for n3 number of times." Rather, Heid merely describes a curved k-space trajectory that produces a spiral sampling of k-space. Interpolation samples are arranged on a rectangular grid in k-space and are generated by interpolating (14) the spiral samples (4), King merely describes a method of magnetic resonance imaging using sampling points on an anisotropic spiral trajectory, Miyazaki merely describes data reconstruction through pixel addition or maximum intensity projection (MIP), and Goto merely describes a method of magnetic resonance imaging incorporating pulse sequences which are repeated.

Notably, none of Heid, King, Miyazaki, and Goto, separately or in combination, describes or suggests "forming a nested loop, the nested loop comprising…frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i…phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding…phase encoding radially for n2 number of times…phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding…phase encoding rotationally for n3 number of times…displaying the datasets."

For at least the above reasons, Applicants respectfully submit that Claim 1 is patentable over Heid in view of King, further in view of Miyazaki, and further in view of Goto.

Claims 2-7 depend, directly or indirectly, from independent Claim 1. When the recitations of Claims 2-7 are combined with the recitations of Claim 1, Applicants respectfully submit that Claims 2-7 are likewise patentable over Heid in view of King, further in view of Miyazaki, and further in view of Goto.

Claim 26 recites "a method for a medical examination using a magnetic resonance imaging (MRI) machine …sampling datasets on to an elliptical grid in polar coordinates in a k-space to generate signals representative of an object of interest that is being medically examined, wherein the dataset are frequency encoded in a Z-direction of the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid, said sampling comprises phase encoding in which each datum is represented as m(acos(2πd/n)kx + bsin(2πd/n)ky + ickz, a, b, c, and d are real numbers, m, n, and i are an integers, and kx, ky, and kz being unit basis vectors in the k-space…forming a nested loop, the nested loop comprising…frequency

encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times."

None of Heid, King, Miyazaki, and Goto, separately or in combination, describes or suggests the medical examination of Claim 26. More specifically, none of Hedi, King, Miyazaki, and Goto, separately or in combination, describes or suggests "forming a nested loop, the nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times." Rather, Heid merely describes a curved k-space trajectory that produces a spiral sampling of k-space. Interpolation samples are arranged on a rectangular grid in k-space and are generated by interpolating (14) the spiral samples (4), King merely describes a method of magnetic resonance imaging using sampling points on an anisotropic spiral trajectory, Miyazaki merely describes data reconstruction through pixel addition or maximum intensity projection (MIP), and Goto merely describes a method of magnetic resonance imaging incorporating pulse sequences which are repeated.

Notably, none of Hedi, King, Miyazaki, and Goto, separately or in combination, describes or suggests "forming a nested loop, the nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times."

For at least the above reasons, Applicants respectfully submit that Claim 26 is patentable over Heid in view of King, further in view of Miyazaki, and further in view of Goto.

For at least the above reasons Applicants respectfully request that the Section 103 rejection of Claims 1-7 and 26 be withdrawn.

The rejection of Claims 1-7, 9, 10, 14, 19, 20, and 25 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Pat. No. 6,794,869 to Brittain (hereinafter referred to as "Brittain") in view of U.S. Pat. No. 5,892,358 to King (hereinafter referred to as "King"), further in view of U.S Pat. No. 6,068,595 to Miyazaki et al. (hereinafter referred to as "Miyazaki") and further in view of U.S. Pat. Pub. 2001/0041819 to Goto (hereinafter referred to as "Goto") is respectfully traversed.

King, Miyazaki, and Goto are described above. Brittain describes a system and method for acquiring (116) data to reconstruct MR images across a large FOV with a reduced acquisition time and without discontinuities of the reconstructed images. The magnetic field gradients that are used to excite spins traverse k-space in a uniform trajectory in a k-space dimension that is parallel to a motion (146) of an examination table along a Z-axis. More specifically, MR data is acquired (116) by repeatedly applying an excitation that excites spins and by applying magnetic field gradient waveforms to encode a volume of interest (144). The gradients that are perpendicular to the table motion (146) are divided into k_x-k_y subsets. The data is then Fourier transformed in the direction of table motion (146) along the Z-axis, and a final reconstructed image (130) is formed by gridding and Fourier transforming, in a traverse dimension, a fully sampled data array (120). During reconstruction, the phase encodes could be positioned in the k-space plane in the shape of a spiral, in concentric rings, in rays from the center, or in a Cartesian grid.

Claim 1 recites "a method for a medical examination using a magnetic resonance imaging (MRI) machine comprising…polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid, wherein said phase encoding comprises phase encoding in which each datum is represented as m(acos(2πd/n)kx + bsin(2πd/n)ky + ickz, a, b, c, and d are real numbers, m, n, and i are an integers, and kx, ky,

and kz being unit basis vectors in the k-space...forming a nested loop, the nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times."

None of Brittain, King, Miyazaki, and Goto, separately or in combination, describes or suggests the method of Claim 1. More specifically, none of Brittain, King, Miyazaki, and Goto, separately or in combination, describes or suggests "forming a nested loop, the nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times." Rather, Brittain merely describes a system and method for acquiring (116) data to reconstruct MR images across a large FOV with a reduced acquisition time and without discontinuities of the reconstructed images. During reconstruction, the phase encodes could be positioned in the k-space plane in the shape of a spiral, in concentric rings, in rays from the center, or in a Cartesian grid. King merely describes a method of magnetic resonance imaging using sampling points on an anisotropic spiral trajectory, Miyazaki merely describes data reconstruction through pixel addition or maximum intensity projection (MIP), and Goto merely describes a method of magnetic resonance imaging incorporating pulse sequences which are repeated.

Notably, none of Brittain, King, Miyazaki, and Goto, separately or in combination, describes or suggests "forming a nested loop, the nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times."

For at least the above reasons, Applicants respectfully submit that Claim 1 is patentable over Brittain in view of King, further in view of Miyazaki, and further in view of Goto.

Claims 2-7, 9, 10, 14, 19, and 20 depend, directly or indirectly, from independent Claim 1. When the recitations of Claims 2-7, 9, 10, 14, 19, and 20 are combined with the recitations of Claim 1, Applicants respectfully submit that Claims 2-7, 9, 10, 14, 19, and 20 are likewise patentable over Brittain in view of King, further in view of Miyazaki, and further in view of Goto.

Claim 25 recites "a magnetic resonance (MR) method for medical examinations comprising...injecting a patient with a contrast agent that flows into a vasculature of the patient...acquiring MR signals produced by spins in the vasculature from an MR imaging system...polar phase encoding to generate the MR signals forming datasets representative of the patient by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid, wherein said polar phase encoding comprises phase encoding in which each datum is represented as m(acos(2πd/n)kx + bsin(2πd/n)ky) + jr(acos(2πd/n)kx + bsin(2πd/n)ky) + ickz, a, b, c, d, and r are real numbers, m, j, n, and i are an integers, and kx, ky, and kz being unit vectors in the k-space...forming a nested loop, the nested loop comprising...frequency encoding the datasets m1 times along a kz axis by keeping m, a, d, n, b, j, r, and c constant, and varying i...phase encoding radially once by keeping a, d, n, b, j, r, and c constant and varying m for every m1 number of times of frequency encoding...phase encoding radially for m2 number of times...phase encoding translationally once by keeping a, d, n, b, r, and c constant and varying j for every m2 number of times of radial phase encoding...phase encoding translationally for m3 number of times...phase encoding rotationally once by keeping a, n, b, r, and c constant and varying d for every m3 number of times of translational phase encoding...phase encoding rotationally for m4 number of times."

None of Brittain, King, Miyazaki, and Goto, separately or in combination, describes or suggests the magnetic resonance method for medical examinations of Claim 25. re specifically, none of Brittain, King, Miyazaki, and Goto, separately or in combination, describes or suggests "frequency encoding the datasets m1 times along a kz axis by keeping m, a, d, n, b, j, r, and c constant, and varying i...phase encoding radially once by keeping a, d, n, b, j, r, and c constant and varying m for every m1 number of times of frequency

encoding...phase encoding radially for m2 number of times...phase encoding translationally once by keeping a, d, n, b, r, and c constant and varying j for every m2 number of times of radial phase encoding...phase encoding translationally for m3 number of times...phase encoding rotationally once by keeping a, n, b, r, and c constant and varying d for every m3 number of times of translational phase encoding...phase encoding rotationally for m4 number of times." Rather, Brittain merely describes a system and method for acquiring (116) data to reconstruct MR images across a large FOV with a reduced acquisition time and without discontinuities of the reconstructed images. During reconstruction, the phase encodes could be positioned in the k-space plane in the shape of a spiral, in concentric rings, in rays from the center, or in a Cartesian grid. King merely describes a method of magnetic resonance imaging using sampling points on an anisotropic spiral trajectory, Miyazaki merely describes data reconstruction through pixel addition or maximum intensity projection (MIP), and Goto merely describes a method of magnetic resonance imaging incorporating pulse sequences which are repeated.

Notably, none of Brittain, King, Miyazaki, and Goto, separately or in combination, describes or suggests "frequency encoding the datasets m1 times along a kz axis by keeping m, a, d, n, b, j, r, and c constant, and varying i...phase encoding radially once by keeping a, d, n, b, j, r, and c constant and varying m for every m1 number of times of frequency encoding...phase encoding radially for m2 number of times...phase encoding translationally once by keeping a, d, n, b, r, and c constant and varying j for every m2 number of times of radial phase encoding...phase encoding translationally for m3 number of times...phase encoding rotationally once by keeping a, n, b, r, and c constant and varying d for every m3 number of times of translational phase encoding...phase encoding rotationally for m4 number of times."

For at least the above reasons, Applicants respectfully submit that Claim 25 is patentable over Brittain in view of King, further in view of Miyazaki, and further in view of Goto.

For at least the above reasons, Applicants respectfully request that the Section 103 rejection of Claims 1-7, 9, 10, 14, 19, 20, and 25 be withdrawn.

The rejection of Claims 1-9, 11, 13, and 15 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Pub. No. 2002/0175683 to Mertelmeier et al. (hereinafter referred to

as "Mertelmeier") in view of U.S. Pat. No. 5,892,358 to King (hereinafter referred to as "King"), further in view of U.S Pat. No. 6,068,595 to Miyazaki et al. (hereinafter referred to as "Miyazaki") and further in view of U.S. Pat. Pub. 2001/0041819 to Goto (hereinafter referred to as "Goto") is respectfully traversed.

King, Miyazaki, and Goto are described above. Mertelmeier describes that the Fourier space, spatial frequency domain or k-space inverse to the spatial or image domain, which the test subject is located, is scanned with a raster of polar coordinates. The graphic presentation of the magnetization, however, is in Cartesian coordinates. The magnetic resonance image then can be generated by re-interpolating the received magnetic resonance signals onto a Cartesian grid and by performing a two-dimensional Fourier transformation.

Mertelmeier also describes a method for fast acquisition of a magnetic resonance image. The method includes using a slice selection gradient in the Z-direction of a rectangular XYZ-coordinate system, and using two gradient fields oriented perpendicularly to the Z-direction and to one another, as a field Gx in the X-direction and a field Gy in Y-direction. However, a phase coding gradient is not used, and, instead, only one frequency coding gradient is used, and possibly a slice selection gradient, if the nuclear spins in only one slice are to be excited. The imaging zone (FOV) is subdivided (100) into sub-regions (fov_i), wherein an antenna (14A-14D) of an antenna array (14) is allocated to each sub-region (fov_i). Each antenna (14A-14D) has a known position relative to the projection center, and the antennas (14A-14D) simultaneously receive the magnetic resonance signals. The antennas (14A-14D) respectively form reception signals from the received magnetic resonance signals according to their sensitivity. Partial images are reconstructed and combined.

Claim 1 recites "a method for a medical examination using a magnetic resonance imaging (MRI) machine comprising...polar phase encoding to generate a plurality of signals forming datasets representative of an object by frequency encoding in a Z-direction of a k-space, wherein the datasets form an elliptical grid in polar coordinates in the k-space, the Z-direction substantially parallel to a center axis of the elliptical grid, wherein said phase encoding comprises phase encoding in which each datum is represented as m(acos(2πd/n)kx + bsin(2πd/n)ky + ickz, a, b, c, and d are real numbers, m, n, and i are an integers, and kx, ky, and kz being unit basis vectors in the k-space...forming a nested loop, the nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c

constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times."

None of Mertelmeier, King, Miyazaki, and Goto, separately or in combination, describes or suggests the method of Claim 1. More specifically, none of Mertelmeier, King, Miyazaki, and Goto, separately or in combination, describes or suggests "forming a nested loop, the nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times." Rather, Mertelmeier merely describes using a slice selection gradient in the Z-direction of a rectangular XYZ-coordinate system, and using two gradient fields oriented perpendicularly to the Z-direction and to one another, as a field Gx in the X-direction and a field Gy in Y-direction. However, a phase coding gradient is not used, and, instead, only one frequency coding gradient is used, and possibly a slice selection gradient, if the nuclear spins in only one slice are to be excited. King merely describes a method of magnetic resonance imaging using sampling points on an anisotropic spiral trajectory, Miyazaki merely describes data reconstruction through pixel addition or maximum intensity projection (MIP), and Goto merely describes a method of magnetic resonance imaging incorporating pulse sequences which are repeated.

Notably, none of Mertelmeier, King, Miyazaki, and Goto, separately or in combination, describes or suggests "forming a nested loop, the nested loop comprising...frequency encoding n1 times along a kz axis by keeping m, a, d, b, n, and c constant, and varying i...phase encoding radially once by keeping a, d, b, n, and c constant and varying m for every n1 number of times of frequency encoding...phase encoding radially for n2 number of times...phase encoding rotationally once by keeping a, b, n, and c constant and varying d for every n2 number of times of radial phase encoding...phase encoding rotationally for n3 number of times."

For at least the above reasons, Applicants respectfully submit that Claim 1 is patentable over Mertelmeier in view of King, further in view of Miyazaki, and further in view of Goto.

Claims 2-9, 11, 13 and 15 depend, directly or indirectly, from independent Claim 1. When the recitations of Claims 2-9, 11, 13 and 15 are combined with the recitations of Claim 1, Applicants respectfully submit that Claims 2-9, 11, 13 and 15 are likewise patentable over Mertelmeier in view of King, further in view of Miyazaki, and further in view of Goto.

For at least the above reasons, Applicants respectfully request that the Section 103 rejection of Claims 1-9, 11, 13, and 15 be withdrawn.

In view of the foregoing amendment and remarks, all the claims now active in this application are believed to be in condition for allowance. Reconsideration and favorable action is respectfully solicited.

Respectfully submitted,

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